

STRUCTURAL METHODOLOGY OF SOCIAL NETWORK MEASUREMENT – HISTORICAL OUTLINE AND CONTEMPORARY APPLICATION FIELDS

Introduction

Celem artykułu jest wskazanie możliwości aplikacyjnych analizy sieciowej w odniesieniu do identyfikacji i rozpoznania sieci relacji rynkowych, które w globalnej gospodarce opartej na wiedzy tworzą skomplikowaną strukturę wielopoziomowych i wieloaspektowych struktur.

The structural methodology in social science is based on the investigation of interactions among the so called social actors. The relationships in the network analysis are perceived as relationships between individuals. Network analysis is a tool to recognize and reveal patterns of social life, which – on the one hand – have a cognitive significance as regards the whole structure and – on the other – have definite consequences regarding the actors, the participants of the network. Network analysis makes it possible to discover the interaction patterns and it helps define the conditions in which such patterns emerge.

The aim of the article is to present the application opportunities of the network analysis as regards the identification and recognition of the market relationship networks, which in the knowledge-based global economy create a complex framework of multi-level and multi-aspect structures.

1. Theoretical assumption of social network analysis (SNA)

The idea to investigate patterns of interactions and relationships by social science is a new one. Before establishing the mainstream of network research, social scientists considered four areas of measurement:

- they aimed at the explanation of basic structural institutions by means of regular investigation of social patterns,
- they collected data concerning behavior, which took the form of actor-actor dyads,

- they discovered procedures with the aim to construct or visualize interaction patterns,
- they generated calculation procedures or determined the characteristics of social patterns by quantitative mathematical functions.

The term *social network* has been functioning in sociology since 1950s. It was first used by J. Barnes with reference to a set of social relationships among the members of a local community, irrespectively of cultural norms¹. The term is used to connote a pattern of links or a set of objects among defined groups of actors (individuals, groups, organizations, communities, society, etc) investigated together with the interpretation and description of the ties between them. The network as a whole may constitute the basis for the interpretation of the social behavior of actors that are the elements of the network². On the basis of the network analysis, emergent and overindividual phenomena can be distinguished and the internal and hidden structure of market relationships can be identified. The term network designates consistently the social relationships among the actors.

SNA is a structural analysis, based on a particular, formal understanding of a structure³. The term *network analysis* was probably taken from the so called operational research⁴. SNA provides alternative explanation of the actors' behavior; it does not treat social processes as a sum of attributes or internal norms but it enables the selection of emergent phenomena that emerge as a result of a mutual interaction. The SNA modeling enables the investigators to conceptualize the network structures through the determination of relationship patterns, diffusion of information among the actors and also to understand how individuals affect and shape the network structural environment. The popularization of the idea of the network methods was started in the early 1970s by H.C. White, who together with his co-workers and students contributed to the development of the theory and the network investigations. In

¹ J. Barnes, *Class and Committee in a Norwegian Island Parish*, „Human Relations” 1954, nr 7, pp. 39–58.

² R.D. Alba, *Taking Stock of Network Analysis: A Decade's Results* [in:] S.B. Bacharach, JAI Press, Greenwich (ed.), *Research in the Sociology of Organizations*, CT 1982., p. 40; J.R. Lincoln, *Intra- (and Inter) Organizational Networks* [in:] *Research in the Sociology of Organizations*, ed. S.B. Bacharach, JAI Press, Greenwich, CT 1982, pp. 255–294, quote from A. Seurert, G. Krogh, A. Bach, *Towards Knowledge Networking*, „Journal of Knowledge Management” 1999, t. 3, No 3, p. 189–190; J.C. Mitchell, *The Concept and Use of Social Networks* [in:] *Social Networks in Urban Situations*, ed. J.C. Mitchell, Manchester University Press, Manchester 1969, pp. 1–12; N. Tichy, M. Tushman, C. Fombrun, *Social Network Analysis for Organizations*, „Academy of Management Review” 1979, vol. 4, pp. 507–519.

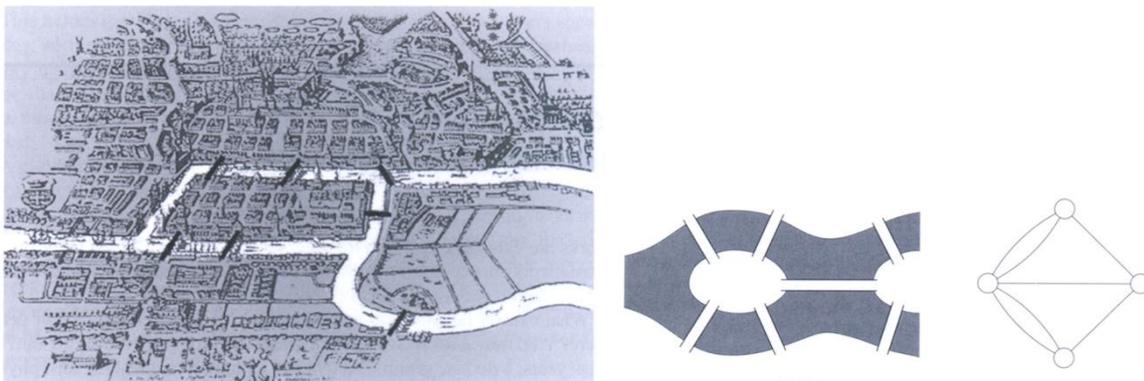
³ B. Wellman, *Structural Analysis from Method and Methapor to Theory and Substance* [in:] *Social Structures: A Network Approach*, red. B. Wellman, S.D. Berkowitz, Cambridge 1988, quote form T. Sozański, *Sieć społeczna* [in:] *Encyklopedia socjologii*, t. 4, Oficyna Naukowa, Warszawa 2002, pp. 28–36.

⁴ L.R. Ford Jr., D.R. Fulkerson, *Przepływy w sieciach*, PWN, Warszawa 1969; B. Korzan, *Elementy teorii grafów i sieci – metody i zastosowania*, Wydawnictwa Naukowo-Techniczne, Warszawa 1978.

order to understand the theory behind the assumptions of SNA, theoretical basis and the trends of its development should be analyzed and determined. They will be presented below in a retrospective approach. The following boundary periods can be assumed: 1) precursory period (1930s), 2) period of SNA stagnation (1940s – 1960s), 3) period of well based SNA methodology (1970s), 4) present-day development of network methods, supported by IT and graphic technologies (since 1980 to date) .

Precursory period. Before methodological handbooks on network analysis appeared, theory of graphs and the mathematical monographs of F.Harary and the co-workers were the basic source of information. However, already in 1736 L.Euler presented the problem of bridges in Konigsberg (fig 3.1). The problem was as follows: is it possible to cross all the bridges in the city a way that would involve crossing each bridge exactly once? L.Euler proved that it was impossible and it was because of the odd number of exits on each of the islands and both banks of the river. The followers of the Swiss mathematicians developed the graph theory into a branch in discrete mathematics ⁵.

Fig.1. Picture of the city of Konigsberg and its seven bridges across the Pregole river. Beside the graph as the image of the situation



Source: *The Structure and Dynamics of Networks*, red. M. Newman, A.-L. Barabási, D.J. Watts, Princeton University Press, Princeton, NJ 2006.

In 1930s, J.L.Moreno established the fundamentals of SNA, which resulted directly from the graph theory. Sociometry – which at first was called by him a *psychological geography* – was understood as an experimental method that required an inquiry into the

⁵ Graph theory enabled scientists to visualize two different types of relationships between points with the application of double lines and arrows. It showed positive and negative states and provided a better way of analyzing complex social procedures, which could be analyzed mathematically and statistically.

evolution and organization of a group and the position of individuals within the group⁶. J.L. Moreno defined an approach to the description of social networks by defining their properties. Some other results of his research are also worth mentioning: the development of empirical data measurement methods, the development of visualization techniques and the development of mathematical models describing networks. J.L. Moren's work initiated the interest in the structural orientation in the investigations on social networks

Simultaneously to the investigations of J.L. Moren, a scientist from the Harvard University - Ch. River (Graduate School of Business Administration), and also L.J. Henderson, G.E. Mayo, F. Roethlisberger, W.L. Warner and T.N. Whitehead – conducted observations and investigations aiming at the discovery of the interaction patterns that occurred among social actors. In order to describe a social structure, in the description they applied mainly such group indicators as hidden local structures (coteries) or group stratification. In their research they took advantage of the knowledge in sociology, anthropology and ethnography. The group worked out a systematic analysis method of interactions; however, it did not determine any structural dimensions in SNA modeling⁷. In conclusion, the research of both groups in 1920s and 1930s created theoretical and methodological fundamentals of network research approach in social science.

Period of stagnation. Since 1940s till 1960s, the network analysis method was treated as a structural theoretical perspective or as a specific approach to data collection and analysis. In 1940s, social scientists, while continuing the structural tradition, penetrated the following issues: the impact of individual behavior on interpersonal relationships (K. Lewin of the Massachusetts Institute of Technology in Michigan), the experiments regarding leadership and data analysis (A. Bavelas, MIT), the generation of formal analytical models (D. Cartwright, MIT), methods of data generation (L. Festinger and T.M. Newcomb from MIT), the investigations with the application of sociometric analysis (L. Katz and Ch.P. Loomis from the Michigan State College), the research on kinship together with the recognition of interaction patterns in marriage and family (C. Lévi-Strauss from Sorbonne and A. Weil from the University of Chicago).

The 1950s were dominated by research dealing with the generation of formal models presenting patterns of relationships in a network (N. Rashevsky from the University of

⁶ L.C. Freeman, *The Development of Social Network Analysis: A Study in the Sociology of Science*, Empirical Press, Vancouver, BC 2004, p. 37.

⁷ Ibidem; J.H. Turner, *Struktura...* op. cit.

Chicago), the recognition of migration patterns in the Swedish population (T. Hägerstrand, the Lunds Universitet), communication (P.F. Lazarsfield and R.K. Merton from the Columbia University), the diffusion of innovations in medicine (J.S. Coleman, E. Katz and H. Menzel from the Columbia University), the diffusion of information (E. Rogers from the Iowa State University, and later the Michigan State University), the application of network methods in anthropology (J. Barnes, E. Bott, J.C. Michhel, S. Nadel from the Manchester University and the London School of Economics), and the decision-making process in communities (K.W. Deutsch and I. de Sola Pool from MIT).

In 1960s scientists were engaged in the following research issues: group structure analysis (C. Lament from the Sorbonne), social stratification (L. Guttman i E.O. Lauman from the University of Michigan), the determination of the unobservable properties of networks, such as clusters, hierarchy, structural balance (P.M. Blau, J.A. Davis, S. Leinhardt from the University of Chicago and R.J. Mokken from the Universiteit van Amsterdam),

In conclusion, since 1940s till the end of 1960s the effort that was directed on the structural research perspective, was dispersed both as regards the subject matter (investigations were conducted in various scientific fields: sociology, psychology, politology, geography) and the research centers (the structural approach was followed at universities in the USA, France, Netherlands, UK and Sweden). However, the investigations that were conducted in these centers did not result in the creation of a coherent and uniform concept of network analysis⁸.

Period of well based SNA methodology. The popularization of the concept of network methods was initiated in early 1970s by H.C. White (from the Harvard University), who together with his co-workers: P. Bearman, P. Bernard, P. Bonaccich, K.M. Carley, I. Chale, B. Erickson, C.S. Fischerer, M. Granovetter, J. Levine, S.M. Linenberg, R.L. Reiger, B. Wellman, C. Winship and the students contributed to the introduction of network methodology. In Harvard, methods and patterns of network research that included new areas of interest were worked out. A new significant direction of research appeared, which was related to the construction of network models of social positions and roles in a group with the use of blockmodels⁹. Moreover, the issue of structural equivalence of position, which became

⁸ L.C. Freeman, *The Development of Social Network Analysis...*, op. cit., pp. 65–120.

⁹ It is a division of a set of actors into subsets, called blocks, considered together with a set of relationships among them and within. The relationship in the set of blocks, like the blocks themselves, is reconstructed with the application of various methods from the elementary network data, i.e. from the relationships among the actors. The analysis of the role of the position may be applied in networks including more than one relationship.

a milestone in network analysis was investigated more deeply¹⁰. Thanks to the work of H.C.White and his team of scientists, the term of SNA is familiar to social scientist and determines the approach as regards social networks.

2. Contemporary approaches to network analysis in social science and marketing

Three approaches can be distinguished in present-day development of network methodology. The first one is focused on the issue of the formal, mathematical development of network methodology. This is why it was given the name of the formal school of SNA. The second one deals with the development of structural theories that determine the effects of the processes under investigation resulting from the widely understood interaction patterns across various scientific disciplines; this trend is the structural school of SNA. The third one concerns the application of network methods in the area of marketing. A more detailed list of the research issues is given in table 1.

The formal school of SNA investigates the change and development of relationship patterns in social networks in real time. The trend is dominated by the following research areas: modeling scale-free networks (R. Albert, A.-L. Barabási), generating algorithms that enable finding the shortest path between nodes, especially in dense networks with complex structures (D.J. Watts), simulations oriented at the network development in time and real-world applications¹¹ (A.-L. Barabási, M. Buchanan, D.J. Watts), discovering local communities, coteries in social networks (K. Faust, J. Scott, S. Wasserman), the issues of hierarchy in networks (A.-L. Barabási, S.N. Dorogovtsev, E. Ravasz) and assortative mixing (J.-P. Eckmann, D. Gibson, E. Moses, M.E.J. Newman).

The structural school of SNA focuses on the issue how interaction and relationship patterns affect the features being investigated by particular fields of science. The approach includes the following most frequent research areas: defining the terms and key notions that occur in network methodology, testing the existing structural theories unique for a particular

See: S.A. Boorman, H.C. White, *Social Structures from Multiple Networks II: Role Structures*, „American Journal of Sociology” 1976, No 81, pp. 1384–1446; H.C. White, S.A. Boorman, R.L. Breiger, *Social Structure from Multiple Networks I: Blockmodels of Roles and Positions*, *ibidem*, nr 51, pp. 730–781.

¹⁰ F.P. Lorrain, H.C. White, *Structural Equivalence of Individuals in Social Networks*, „Journal of Mathematical Sociology” 1971, nr 1, pp. 49–80.

¹¹ The modeling aims at the consideration of the dynamic process of network creation, which results in the addition or subtraction of vertices and/or edges

discipline, searching for network cases that describe the SNA phenomenon, and discovering the open and hidden network properties and effects (the equivalence, network position, power, prestige, reasons for appearing in the network, etc.)¹².

Network analysis is being increasingly applied in the research work in marketing due to its specific character that differentiates significantly network methodology from the classical method of marketing research. As a result of the analysis, it is possible to determine relationship patterns between the interaction partners (producer – distributor, salesman – buyer, etc) and, which is important, it helps recognize the hidden emergent properties in the structure of market interactions.

The interest in the network analysis in marketing could be already seen in the investigations in 1950s and 1960s; however, the degree of the application of the network methodology was rather insignificant then. Only such issues as the diffusion of innovation (J.S. Coleman, E. Katz, H. Menzel) or the informal influence of a group on consumer purchasing behavior (J.E. Stafford, R.E. Witt) were investigated.

In 1970s there was a substantial increase of interest in the network methodology in marketing. The research concerned mainly the application of the sociometric analysis in marketing (J.A. Czepiel), innovativeness (G.R. Dowling, D.F. Midgley), WOM communications (J.A. Czepiel, A. Martilla), informal communication on industrial markets (F.E. Webster) and purchase behavior, especially the influence of social groups on purchasing decisions (G.D. Bruce, R.E. Burnkrant, A. Coutsineau, R.E. Witt).

In 1980s, the research on the above mentioned issues was continued, including WOM communications (J.J. Brown, P.H. Reingen) and consumer behavior (W.O. Bearden, J.J. Brown, M.J. Etzel, B.L. Foster, S.B. Seidman). At the same time, research on such new areas of the application of network methodology in marketing was started as the institutional purchase decision-making processes on international markets (E.C. Hirschman, D. Mazursky), the relationships in shopping centers (J.M. Bristor, M.J. Ryan), the definition of marketing strategy in the context of exchange networks (M.D. Hutt, P.H. Reingen, J.R. Ronchetto) and the pattern of behavior of institutional buyers (M.D. Hutt, R.T. Moriarty, J.R. Ronchetto, R.E. Spekman).

¹²M. Newman, A.-L. Barabási, D.J. Watts (ed.), *The Structure and Dynamics of Networks*, Princeton University Press, Princeton, NJ 2006.

At present, the research as regards network methods in marketing concerns the issues that were mentioned before, i.e. consumer behavior patterns (R.P. Bagozzi, G. Henderson, B. Kline, J.C. Ward), the behavior patterns of institutional entities (G.L. Frankwick, M.D. Hutt, R.B. Money, P.H. Reingen), the diffusion of innovations on institutional markets (D.F. Midgley, P.D. Morrison) and communication patterns (A. Griffin, J.R. Hauser) on the one hand, and the issues related to the new areas of the application of network methodology on the market and in marketing, on the other. They include: the determination of the network paradigm in relational marketing (R.S. Achrol, Ph. Kotler), the influence of information control in shopping centers (P.L. Dawes, G.R. Dowling, D.Y. Lee), the flow of information on the market (J. Frenzen, K. Nakamoto), the social capital (S. Ghoshal, J. Nahapiet) and the relationship networks in virtual communities (R.P. Bagozzi, U.M. Dholakia).

Tabel 1. SNA research areas in 1920 - 2010

	Formal approach	Structural approach	Application approach in marketing
1920s	no publications	<ul style="list-style-type: none"> • conceptualization of net twork methods, definitions (J.L. Moreno) • decision-making processes (making choices) by children (H. Bolt, B. Wellman) • the impact of intelligence on the choice (J. Alamck) • network visualization (J.L. Moreno) 	no publications
1930s	<ul style="list-style-type: none"> • sociometry (D.M. Davidson, Ch.P. Loomis, J.L. Moreno) • statistical approach to social configurations (H.H. Jennings, J.L. Moreno) 	<ul style="list-style-type: none"> •interaction patterns among pre-school children, friendship bonds (E.P. Hagman, L.M. Jack, M.L. Page) • patterns of aggressive behavior (K. Levin, R. Lippitt) 	no publications
1940s	<ul style="list-style-type: none"> • matrix analysis (R.D. Luce, A. Perry) • sociometric analysis (D.M. Davidson Jr., L. Katz, Ch.P. Loomis, R.M. Powell) • mathematical biology (W.C. Allee, A. Rapoport, N. Rashevsky) • mathematical modeling of small groups (A. Bavelas) 	<ul style="list-style-type: none"> • relationship measurement in psychology (E. Chapple) • street community (W.F. Whyte) • social structure (A.R. Radcliff-Brown) • ties and relationships in family (I.-J. Bienayme, L.F.B. de Chatauneuf) • social behavior - domination and integration (H.H. Anderson), co-operation and competition (M. Deutsch), leadership and isolation (H.H. Jennings) 	no publications

<p>1950s</p>	<ul style="list-style-type: none"> • graph theory (C. Berge, F. Harary, R.Z. Norman) • sociometry (J. Nehnevajona) • structural balance (D. Cartwright, F. Harary) • procedures of determining coteries in matrixes (F. Harary, I.C. Ross) • approximation methods in diffusion processes (H.D. Landahl) • random network (H.G. Landau, A. Rapoport, R. Solomonoff) • biased nets (A. Rapoport) • mathematical models of information flow (H.G. Landau, A. Rapoport) 	<ul style="list-style-type: none"> • social groups, interactions (G.C. Homans), coherence (J.W. Thibaut) • communication K. Back, K.W. Deutsch, L. Festinger, C. Flamnet, H.J. Leavitt, N. Rashevsky, S. Schachler, S.L. Smith, J.W. Thibaut) • innovation diffusion (J.S. Coleman, E. Katz, H. Menzel) • technology adaptation (G.M. Beal, E.M. Rogers) • family, kinship, ties (E. Bott, C.D. Forde, L.H. Morgan, A.R. Radcliff-Brown, A. Reginald) • innovation networks (T. Hägerstrand) • election status versus economical status (Ch.P. Loomis, Ch.H. Proctor) • social structure: clusters (J. Barnes), social influence (L. Festinger, S. Schachter), personal influence (E. Katz, P.E. Lazarsfeld), friendship (P.E. Lazarsfeld, R.K. Merton) • reciprocity of choices (L. Katz, J.H. Powell) 	<ul style="list-style-type: none"> • change of product groups (L.L. Berry, W.L. Garrison) • communication in organization (H. Guetzkow, H.A. Simon)
<p>1960s</p>	<ul style="list-style-type: none"> • algebra of group kinship (J.P. Boyd) • sociometric data (J.S. Coleman, D. MacRae) • stochastic models for social groups (T.N. Bhargava, E. Katz) • structural models of kinship and relation (P. Courrage) • sociometry (H.H. Jennings, J.L. Moreno), data (W.J. Horvath, A. Rapoport), data analysis (S. Spilerman) • graph theory: application (Ø. Ore, F.R. Pitts), balance (J.A. Davis), directed graphs (D. Cartwright, F. Harary, R.Z. Norman) 	<ul style="list-style-type: none"> • networks in towns and cities (A. Barton, J.C. Mitchell) • the analysis of professional groups: professional structure: (P.M. Blau, O.D. Ducan), contacts of professional groups (E.O. Lauman, L. Guttman) • communication (C. Flamnet) • political communication (M. Deutsch) • conflict (L.C. Freeman), leadership (W. Bloomberg, T.J. Fararo, L.C. Freeman, S. Koff) • acquaintance in networks (H. Gurevitch, T.M. Newcomb, H. Rosenthal) • small world issue (S. Milgram, J. Travers) 	<ul style="list-style-type: none"> • group influence effect on brand preference (J.E. Stafford, R.E. Witt) • communication on industrial markets (C.M. Webster) • diffusion of innovations (E.M. Rogers)

		<ul style="list-style-type: none"> geographical space (W.R. Tobler) 	
1970s	<ul style="list-style-type: none"> relational data: algorithm, clusters (R.L. Breiger, S.A. Boorman), hierarchy in graphs (J.A. Davis), homomorphism (G.H. Heil, H.C. White) network, relational data (H.R. Bernard, P.D. Killworth) directed graphs (J.M. Antonisse) block models: the role and status (H.C. White) computer software COMPLET (R.D. Alba), SOCK (R.D. Alba, M.P. Guttman), SOCPACI (S. Leinhardt), NEGOPHY (W.D. Richards), SONET-1 (B.L. Foster, S.B. Seidman) sociometry: coteries (R.D. Alba), structure (Ch. Winship) structural statistics (P.A. Ballonoff) theory of anticipation (C. Heyde) 	<ul style="list-style-type: none"> family analysis (E. Bott, F. Galton, H.W. Watson) social structure analysis (H.R. Bernard, S.A. Boorman, P.D. Killworth, H.C. Whill), social role (S.A. Boorman, R.L. Breiger, H.C. White), interpersonal relationships (J.A. Davis, S. Leinhardt), elites (E.O. Lauman, F.U. Pappi), structural equivalence (F. Lorrain, L.D. Sailer, H.C. White), coteries (R.J. Mokken), strong bonds (Y. Bian), centrality (L.C. Freeman), the power of weak bonds (M. Granovetter), power (H.M. Helmers, R.J. Mokken), social influence (M. Kochen, I. de Sola Pool) networks in towns and cities (J.A. Barnes, S. Leinhardt) social networks (J.A. Barnes, S. Leinhardt) structure of organization (P.M. Blau, R.A. Schoenherr) 	<ul style="list-style-type: none"> informative and social impact on purchase behavior (R.E. Burnkrant, A. Counsineau, R.E. Witt) information diffusion (J.A. Czepiel) WOM communication processes (J.A. Czepiel, J.A. Martilla, C.M. Webster) implementing sociometric techniques (J.A. Czepiel) innovativeness (G.R. Dowling, D.F. Midgley), (R.E. Burnkrant, A. Counsineau, R.E. Witt)
1980s	<ul style="list-style-type: none"> network analysis (S.D. Berkowitz, D. Knoke, J. Kukliński, B. Wellman) retrospective data (H.R. Bernard, P.D. Killworth) computer communication (L.C. Freeman) computer software COBLOC (P. Carrington, G.H. Heil), GRADAP (J.M. Antonisse, R. Mokken, F.N. Stockman), CENTER (L.C. Freeman), SONIS (P. Kappelhoff, F.U. Pappi), Ucinet (S.P. Borgatti, M.G. Everet, L.C. Freeman) social role (R.L. Breiger, E.M. Pattison) fuzzy networks, coteries (X. Yan) network research methods (L.C. Freeman, A.K. 	<ul style="list-style-type: none"> social capital (J.S. Coleman) structural models in anthropology (P. Hage, F. Harary) SNA paradigm (R.D. Alba) social ties, relationships (E. Baumann, S. Feld, P. Masden, D. Prensky) communication in network (D.L. Kincard, E.M. Rogers) network social survey (R.S. Burt) social structure (M. Granovetter, P.V. Marsden, N. Lin) cumulative effects (L.C. Freeman), social interaction (L.C. Freeman, S.C. Freeman, A.G. Michaelson), centrality of 	<ul style="list-style-type: none"> network analysis in marketing (J.B. Keman, P.H. Reingen) shopping centers (J.M. Bristor, M.D. Hutt, P.H. Reingen, J.R. Ronchetto, M.J. Ryan) emergent process in defining a marketing strategy (M.D. Hutt, P.H. Reingen, J.R. Ronchetto) WOM communication (J.J. Brown, P.H. Reingen) consumer purchasing criteria: the influence of group on product selection (W.O. Bearden, M.J. Etzel), merchandising (R. Ettenson, J. Parrish, J. Wagner)

	Romney, D.R. White), homomorphism (H.C. White)	position (L.C. Freeman, R.R.Mulholland,D. Roeder), power (B. Mintz, M. Schwartz, J. Scott, F.N. Stockman, R. Zeigler), homophily (J.M. McPherson, L. Smith-Lovin) • friendship bonds (C.S. Fisher)	
1990s	<ul style="list-style-type: none"> • SNA network analysis (K. Faust, L.C. Freeman, J. Scott, S. Wasserman, B. Wellman) • domination, hierarchy (L.C. Freeman, A.K. Romney) • estimation of network size (H.R. Bernard, E. Johnsen, P.D. Killworth, Ch. McCarthy, G.A. Shelly) • undirected graphs (T. Kamada, S. Kawei) • scale-free networks (R. Albert, A.-L. Barabási) • ego-centered networks (A. Marin, Ch. Muller, B. Wellman) • social context of a group (L.C. Freeman) 	<ul style="list-style-type: none"> • theory of social activity (A. Abbot) • emergence • small world issue (J.J. Collins, C.C. Chow, S.H. Strogatz, D.J. Watts) • diffusion (A.G. Michaelson) • SNA (K. Faust, S. Wasserman), structural context of opportunities (P.M. Blau), structural holes (R.S. Burt), culture, classes (B. Erickson), isolation (R.M. Fernandez, D. Harris) • friendship networks (D. Brewer, C. Webster), neighborhood networks (K. Campell, B. Lee) • social capital (R.S. Burt) • epidemiology (M. Morris) 	<ul style="list-style-type: none"> • analysis of quotations (M.S. Roth, G.M. Zinkhen) • shopping centres (P.L. Dawes, G.R. Dowling, D.Y. Lee) • dyadic interactions (N. Hopkins, D. Iacobucci) • dyadic business relationships (J.C. Anderson, H. Håkansson, J. Johanson) • actor's equivalence on the B2B market (G. Henderson, N. Hopkins, D. Iacobucci) • intellectual and social capital (S. Ghoshal, J. Nahapiet) • brand preference maps versus assortative network (B.J. Calder, G.R. Henderson, D. Iacobucci) • negotiations (R.B. Money) • B2B partnership (J.C. Anderson, J.A. Narus) • consumer preferences (M. Chandrashekar, P.H. Reingen, B.A. Walker, J.C. Ward) • diffusion (D.F. Midgey, P.D. Morrison, J.H. Roberts) • retail purchase (B. Kline, J. Wagner) • relationships in marketing (R.S. Achrol) • network approach to marketing (R.S. Achrol, D. Iacobucci, Ph. Kotler) • weak relationships in organization versus knowledge-sharing process (M.T. Hansen) • SNA in marketing (R.P. Bagozzi, P.A. Dabholkar, G. Henderson, D. Iacobucci)

			<ul style="list-style-type: none"> • communication patterns (A. Griffin, J.R. Hauser) • purchase behavior and brand (J.E. Chagn, G.R. Henderson, D. Iacobucci, A. Marcati)
2000-2010	<ul style="list-style-type: none"> • ego-centered method of data analysis (V. Hlebec, K.L. Manfreda, V. Vehovr) • SNA methodology (L.L. Berry, P. Marsden, E. Otte, R. Rousseau, J. Scott) • software on relational data management (C. Butts) • computer software Pajek (V. Batagelj, A. Mrvar), Ucinet 6.0 (S.P. Borgatti, M. Everett, L.C. Freeman) • network visualization (K.M. Carley, J.-A. Carrasco, B. Hogan, B. Wellman) 	<ul style="list-style-type: none"> • network analysis (S.P. Borgatti, D. Brass, G. Labianca, A. Stephen) • social capital (R.S. Burt, B. Erickson, K. Frank, N. Lin, B. Wellman) • small world issue (M. Buchanan) • structure of social relationships (M. Grossetti), fragmented ties (C. Menjivar) • structure of discussion network (P.S. Bearman, P. Parigi), immigrants' networks (S. Dominguez, I. Maya-Jariego), Internet relationships (J. Boase, B. Wellman), e-neighborhood (K. Hampton), quotation network (N. Nazer, B. Wellman, H.C. White) • structure: links (A.-L. Barabási, P. Bearman, R. Cote, J. Moody, G. Plickert, K. Stovel, B. Wellman), structural holes (R.S. Burt), neighborhood (K. Hampton, B. Wellman), isolation (M. Brashears, J.M. McPherson, L. Smith-Lovin), status (J.M. Podolny) 	<ul style="list-style-type: none"> • information ecology (R.J. Watts, S.A. Watts) • WOM communication (K. Ozcan) • consumer preferences (W. Jager, M.A. Janssen, Y. Yang) • information flow on the market (J. Frenzen, K. Nakamoto) • relationships on foreign markets (B.J. Calder, P.D. Ellis, G.R. Henderson, D. Iacobucci, A. Pecotich, V.K. Rangen) • relationships on B2B market (K.D. Antia, G.L. Frazer) • relationships in distribution channels (K.D. Antia, G.L. Frazer) • virtual communities (R.P. Bagozzi, U.M. Dholakia) • theory of consumer choice (D.E. Allen, N. Mandel) • power, prestige, hierarchy in relationship network (W.S. Hesterly, C. Jones) • commitment and competition (D. Gibson)

Source: Author's presentation based on – L.C. Freeman, *The Development of Social Network Analysis: A Study in the Sociology of Science*, Empirical Press, Vancouver, BC 2004; *Network Theory Bibliography* [on-line], www.marketingpower.com (American Marketing Association).

A third area of issues should also be mentioned, which is new in relation to the research topics that were investigated before and which is related to the development of the network methodology in the field of marketing. Present-day investigations present the analyses results of relational data, i.e. of dyads, triads and networks on industrial (institutional) markets, on service markets (particularly of professional services) and on consumer goods markets (J.C. Anderson, H. Håkansson, D. Iacobucci, J. Johnson). Moreover, contemporary research deals with a significant analytical problem concerning the application of overindividual, unobservable indicators of market networks such as actor's equivalence (G. Henderson, N. Hopkins, D. Iacobucci), power, prestige and hierarchy in the network (S.P. Borgatti, W.S. Hesterly, C. Jones)¹³.

Conclusion

The application of network methodology, which has been present in marketing since 1950s, together with the increasing emphasis on its relational character and the multi-level character of the network systems requires on the part of researchers a particular consideration of the emergent properties of the market relationship structures. The technological progress, especially the one of the Internet, the network character of markets and product servicization result in the situation that such an approach may become one of the fundamental trends in marketing research.

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Abstract

The article characterizes structural research methodology related with measurement. The aim of the paper is to present the investigation areas of SNA in its traditional approach (in social science) and the application opportunities of SNA in multidimensional and multilevel systems of market relationships.